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GMOs

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Panic in the Midwest

The Ogallala Aquifer is drying out. This expansive Midwestern water source sustains most of the United States' wheat supply, and its levels are dropping fast. In recent years, severe drought has depleted the region, alarming many farmers who rely on consistent rainfall for wheat production levels. If the aquifer dries out completely, farmers will have to dramatically change their farming practices, and many families will be forced to adjust to higher-priced wheat.

But what if we could grow wheat that didn't need as much water? Here's where genetically modified organisms (GMOs) come in. The world's largest agricultural companies are currently producing strains of plants with increased drought resistance; one of these is a genetically modified (GM) corn plant that absorbs water more efficiently than unmodified strains of the same corn. If the same research is applied to developing strains of drought-resistant wheat, farmers could increase their revenue and the Ogallala Aquifer could retain its water, keeping a potential food crisis at bay.

The crucial role GMOs could play is not limited to midwestern wheat. With climate change and growing population threatening global food supplies, many see genetic modification as a crucial tool to mitigate these threats. Yet issues relating to GMOs are controversial, inciting explosive dialogue between scientists, government legislators, and natural-food advocates. Unfortunately, the general public has a weak grasp on the science surrounding this polarizing issue, leaving many without much choice — they ultimately align with whomever speaks loudest, or worse, make their decisions out of desperation and fear. This article will take you through the basics of genetic modification and present some the technology's biggest concerns, legitimizing its existence and its role in solving our current crises, hopefully dismantling some of the myths surrounding GMOs.

What is a GMO?

Genetic modification (GM) is the artificial alteration of an organism's genome in order to emphasize one of its desired traits. This can be done in two main ways—by selectively breeding an organism in order to elicit changes in its phenotype, or by directly changing an organism's DNA, known as genetic engineering. Humans have been genetically modifying crops for thousands of years using the former method—in a process called artificial selection. In this process, breeders select animals or plants that exhibit desired levels of a specific trait, and crossbreed these two organisms to eventually cause an entire population to express this desired trait. Using the latter method, genetic engineering, scientists can alter traits of an organism by very precisely engineering changes in its DNA. A GMO is any organism treated with one of the above techniques.

Let's take look at wheat. Wheat is a human-created hybrid that has evolved over many years of cultivation to form the several-species crossbreed we recognize today. In order to genetically modify wheat, sections of the plant are first placed in a dish full of nutrient-containing medium. Bacteria are added that have had their DNA altered to code for the desired gene modification — let's say pesticide resistance. The wheat soaks up the bacteria, incorporating the bacterial genome into theirs. If treated carefully, the wheat sections can be coaxed into growing roots. Once mature, this wheat will express the altered gene, which codes for certain proteins that block a pesticide from harming it in any way.

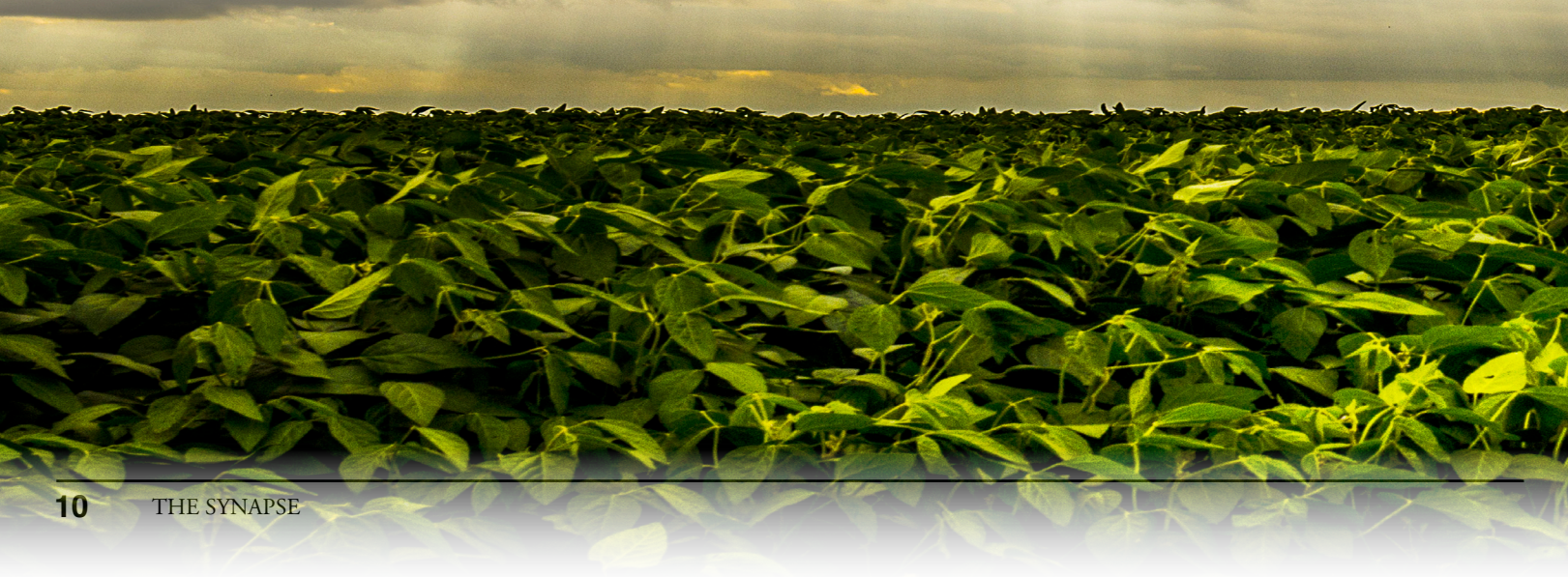
1994 saw the release of the first GM food product: Flavr Savr tomatoes, altered in a way that lengthens ripening time, increases shelf life, and retains flavor. Today, genetic modification has many forms: "Roundup Ready" corn has increased resistance to glyphosate pesticides (Roundup). Bt cotton expresses a protein that is poisonous to certain insects but harmless to humans. Golden rice produces higher levels of beta-carotene, a precursor to vitamin A. This is especially relevant to the developing world, where 1-2 million people die every year due to high levels of vitamin A deficiency (World Health Organization). Golden rice could prove to be an extremely helpful dietary supplement in these regions.

To this date, no GM wheat has been available to the public, despite a decade of research into drought-resistant, pest-resistant, and heat-tolerant plants. A drought-resistant corn strain has been released to the commercial market, but the release of GM wheat has met roadblocks from critics who still deem safety testing unsatisfactory and its impact on health unknown.

GMOs and Health

So what exactly are critics worried about? Naturally, altering our food should call for a certain degree of precaution and speculation. Yet study after study in non-human animals seems to confirm that GM food causes no observable harm to our health.

But in September 2012, this confidence in GMO safety was shaken. Gilles-Eric Séralini fed one group of rats entirely on GM corn, and another group with GM-free products. This experiment lasted two years (the lifespan of a rat), and by the end of the experiment, Séralini discovered something startling: the rats



in the GM group had developed significantly more cancer-related tumors than rats in the control group. Published in the journal Food & Chemical Toxicology, Séralini's results were the first of their kind—here was a study in a peer-reviewed journal that apparently linked GMOs to cancer.

Within 24 hours of the article's publishing, thousands of scientists and media groups responded, mostly with criticisms of the paper's experimental methods and statistical clout. One especially startling piece of information was that the strain of rats used, Sprague-Dawley, is known for its already high incidence of tumors. So to separate any statistical "noise" in experiments that measure rates of tumor incidence, it is recommended to use at least fifty rats per experimental group—Séralini only used ten. This leads to the possibility that any difference between groups exists due to random chance, not due to feeding methods. Others criticized Séralini, who was also the founder of the vocally anti-GMO advocacy group CRIIGEN, of approaching the study with a bias towards results that agreed with his organization's agenda—a big "no-no" in science. Eventually, all the criticisms of the article and Séralini's refusal to voluntarily pull his paper out of the journal led Food & Chemical Toxicology to retract the paper one year later.

So if Séralini's study represents the one piece of evidence against GMO health safety, and it was redacted, does that mean GMOs are safe? Not necessarily. Studies on non-human animals cannot always properly represent complex human biological systems, and many of these studies only address immediate health concerns while neglecting potential long-term health issues. When you conduct a long-term study on human health, you need to first amass a group of participants large enough and design an experiment long enough to demonstrate significant results. You also need a strong control group; in this case a group where every single participant would abstain from consuming any GMO products throughout the course of the study, to compare and contrast any effects seen in the GMO group of interest. But how can you really ensure this today, when in the US, 90 percent of corn and soybean crops are genetically modified? (MIT Technology Review). In other words, a robust control group free of any GMO exposure is a near impossibility.

If the prospect of any real epidemiological studies relating human health to GMOs seems grim, there is good news: we have unwittingly been a part of the largest experiment yet on human health. In the twenty years since the first GM product was released, there have been no noticeable detriments to our health from GM food consumption. But GM food critics are not only concerned with human health.

GMOs and the Environment

Both scientists and non-scientists are interested in the effects GMOs have on their surrounding ecosystem. Take for example, the relationship between cotton and the monarch butterfly. In 1999, the journal Nature published an article that correlated the rise of GM cotton plants expressing Bt (a natural insecticidal bacteria) to lower counts of milkweed, an essential food source for monarch butterflies. It is now understood, however, that the issue of disappearing monarchs is much more complicated than was first assumed. For example, it has been found that drought and other bad weather has decimated the monarch population over recent years, while other studies report correlated impacts due to illegal logging. An increase in pesticides plays a role not only in the monarch's decline, but also in the decline of bees and other pollinators (New York Times, "Setting the Table for a Regal Butterfly Comeback"). In other words, if GMOs play any role in the decline of the monarch butterfly, it is only a piece of a much more complex puzzle that researchers are far from having figured out.

A World with GMOs

Whatever our opinions on GMOs, it is too late to say that that we can live without them. Many of the country's largest crops are genetically modified; ingestion at some point or another of GM corn is practically inevitable. Agricultural companies and governments are in no position to slow down GMO research, since everyone involved benefits: companies sell GM seeds to farmers, who then experience increased crop yield and higher profit margins. This is because GMOs use less pesticides and fertilizer, making it easier for farmers to spend less while bringing in more. GMOs that provide additional nutritional supplements or extend ripening are beneficial to non-farmers as well, and these types of modifications may become increasingly necessary in the future. But as much as a drought-resistant wheat plant may quash concerns in the Midwest, questions still remain on the long-term impacts of GMOs on the environment and, some believe, on aspects of human health. Not to mention the ethical concerns of gene patenting, the corporatization of the agricultural industry, and the labeling of GMO-containing products—all of which are complex issues that I don't have space to tackle here.

But in a nutshell: GM foods have no morals. The biotechnological techniques of genetic engineering are neither inherently good nor bad—they're tools to solve problems that have puzzled humanity for millennia: how do we feed a growing population? How do we make the most of limited resources? And how do we maintain a healthy population amidst a growing need for efficiency? To answer these questions, we need skepticism and creative thinking—not fear-based decision-making.